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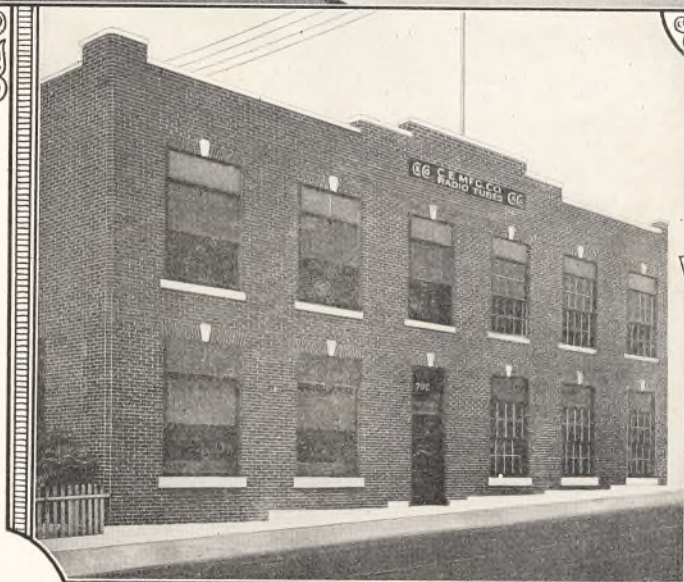
**RADIO
VACUUM
TUBES**

C. E. MANUFACTURING CO. INC.
PROVIDENCE ~ ~ ~ RHODE ISLAND



EC
PRODUCTS

C.E.Mfg.Co.
Largest Plant in
the World Devoted
Entirely to the
Making of
Radio Tubes



CC
RADIO
TUBES

FOREWORD

The C. E. Manufacturing Company, Inc. owns and operates the largest plant in the world devoted exclusively to the making of radio tubes. This position of leadership in a great and increasingly important industry is not a result of chance or circumstance. It is due primarily to the outstanding QUALITY of the product,—“CECO Tubes,” and to the liberal and far sighted policies which have guided the CeCo business from its very inception.

Wholesalers have found CECO Tubes well and favorably known to their customers—the retailers. Retailers have been enthusiastic boosters of CeCo because of their ready sale to consumers; their long life and steady, satisfactory performance in actual use, which have reduced complaints and requests for adjustments to the very minimum.

Consumers have learned to appreciate the quality of reception, the volume and long life of CeCo Tubes from our extensive and persistent national advertising, through the recommendation of acknowledged radio authorities and by actual use in their own sets.

In the beginning CeCo Tubes were advertised as “Best by Test” in the laboratory; today public opinion of millions of actual users declare them “Best by Performance” in the home.

This catalog is presented in the hope that you will enjoy and profit by this brief story of CeCo Tubes—what they are, how they are made, why they *make any good receiver better*.

C. E. MFG. CO., Inc.
 PROVIDENCE, R. I.

No Product is any Better Than the Manufacturer Behind It.

We present the following brief facts as regards the C. E. Manufacturing Co., Inc.:

1. The C. E. Mfg. Co., Inc., owns and operates the largest plant in the world devoted exclusively to the manufacture of radio tubes.
2. The C. E. Mfg. Co. has unquestionable financial strength. Think what this means—Security to every buyer of a CeCo Tube.
3. The C. E. Mfg. Co. has an exceptionally well-equipped laboratory. This laboratory is never idle. Its services are freely at the disposal of manufacturers, wholesalers and retailers seeking information on tubes or other radio equipment.
4. The C. E. Mfg. Co. plant is splendidly equipped in every department. No expense is spared and no facilities are lacking that will assist in maintenance of quality. The present productive capacity is more than 12,000 tubes per day.
5. The C. E. Mfg. Co. has in its employ men who have been associated with the tube industry and similar lines for the past 21 years.
6. The C. E. Mfg. Co. has a definite sales policy. There is no deviation from quality, and adjustments are fair and promptly made. Advertising is continuous and of National scope, including newspapers, trade magazines and consumer media. Numerous sales helps are offered to dealers, including show cards, window posters, envelope inserts, booklets, etc.

The above facts mean—a quality article—satisfied customers—repeat business—and good profits for you.

View of Physics Laboratory



The C. E. Manufacturing Company is ready at any time to furnish manufacturers or individuals with technical information. They have an exceptionally well equipped Physics Laboratory and an excellent Engineering Department. If you at any time desire information pertaining to the operation and function of "CeCo" tubes, address your communication to this department.

A view of the Physics Laboratory is shown above.

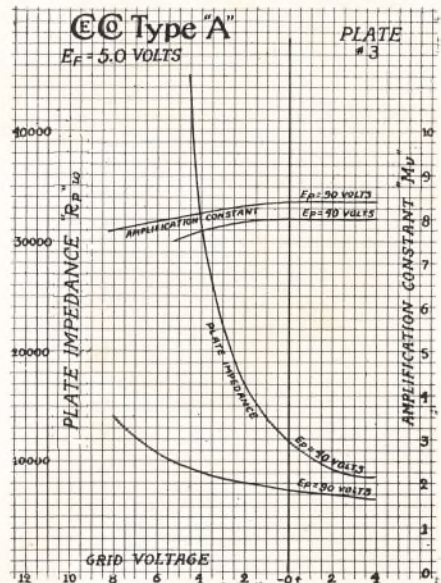
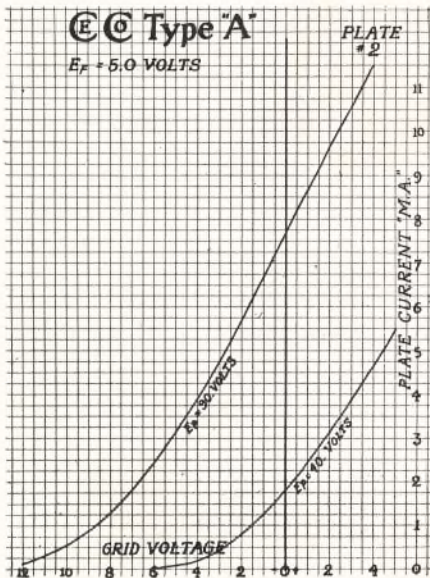
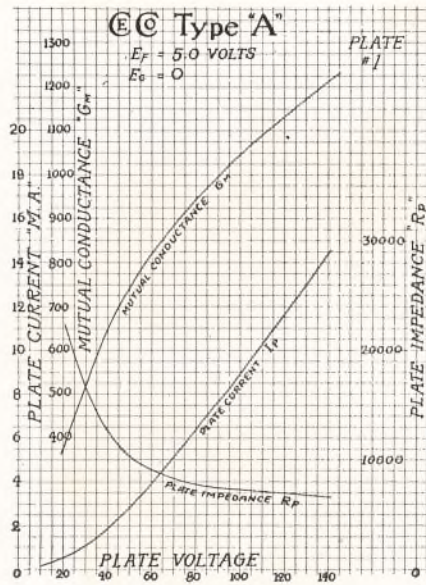
View of Seasoning and Testing Dept.



Before radio tubes are shipped to the consumer, it is essential that they are aged or seasoned and very carefully tested by the manufacturer.

"CeCo" tubes are tested for the following characteristics:—Grid Current, Filament Current, Plate Current, Saturation Current, Plate Impedance and Amplification Constant. The limits used by the C. E. Manufacturing Company are very stringent. This assures the consumer that he is getting uniform tubes.

Characteristics of CeCo Tubes



CHARACTERISTICS OF CECO TUBES

Ceco Type "A"

A general purpose tube suitable for use in any storage-battery set as Radio Frequency and Audio Frequency amplifier or Detector.

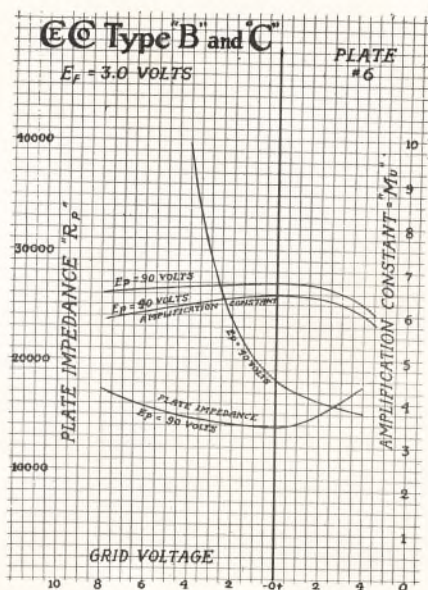
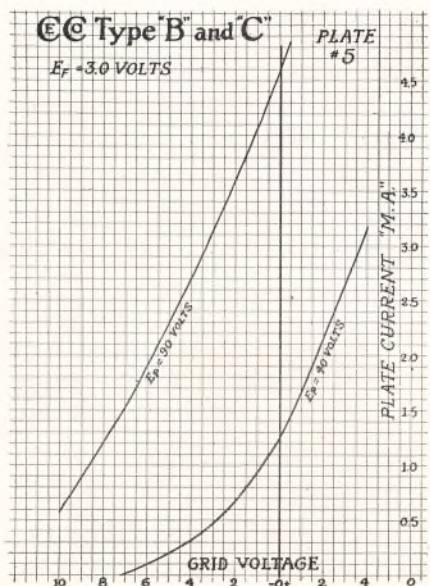
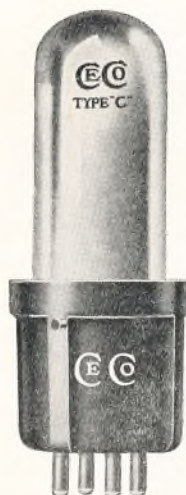
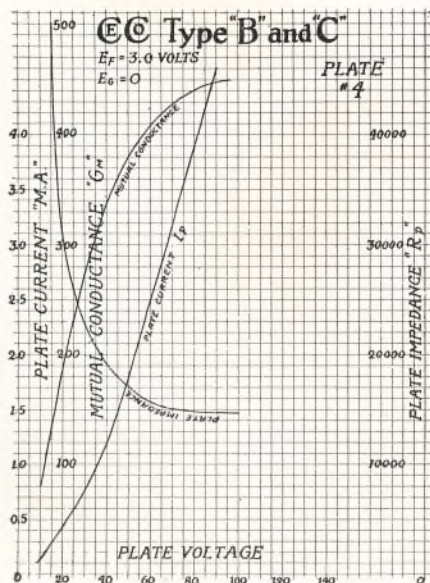
Plate 1 shows the effect of varying plate voltages upon the plate current, plate impedance, and mutual conductance. Note particularly that the plate current rises rapidly with increasing plate voltage, at zero grid bias, while the plate impedance does not fall appreciably, above 60 volts. This indicates that without a C battery little is to be gained by plate voltages above 60, while the drain on the B battery is greatly increased, and the tube life lessened.

Plate 2 shows the effect of grid voltage upon plate current at two different plate voltages. Note that 40 volts with about 2 volts bias will handle a peak voltage of nearly 2 volts with less than 1 M/A drain on the B battery. In transformer coupled radio and audio frequency stages, such voltage input can rarely be exceeded without overloading the last or output tube, unless that be of such power types as F or J-71. Therefore 40 to 60 volts is sufficient for all stages except the output one, when CeCo A tubes are used. This makes for greatly increased B battery life, as the drain is less than 1/3 that needed with the usual 90 volts B battery and 4.5 volts C battery.

On the other hand note that for the last audio tube we need to handle as great an input voltage as possible. Inspection of the curve for 90 volts plate voltage, shows that an input peak of nearly 6 volts may be handled, by using a 6 volt C battery. This is a distinct advantage in comparison with the type usually found on the market, which only allows a peak input voltage of 4.5, and explains why CeCo A tubes function so exceptionally well in the last audio stage.

Plate 3 shows plate impedance and μ plotted against grid voltage. With negative bias, note the extremely slight change of the μ between 40 volts and 90 volts, in contrast to the great difference of the impedances at corresponding voltages. This shows the need of 90 volts to secure good reproduction in the output stage feeding a low impedance speaker.

Characteristics of CeCo Tubes





CeCo Types B — BX — C



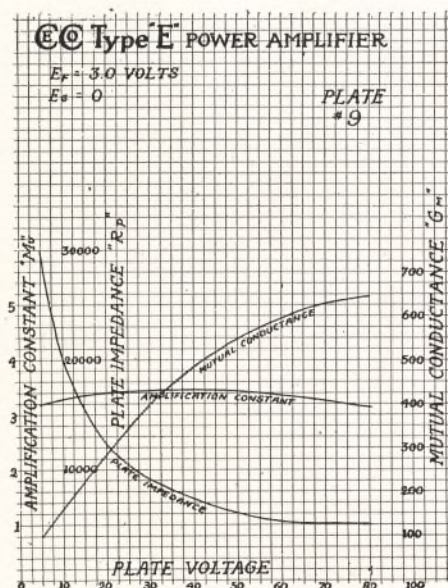
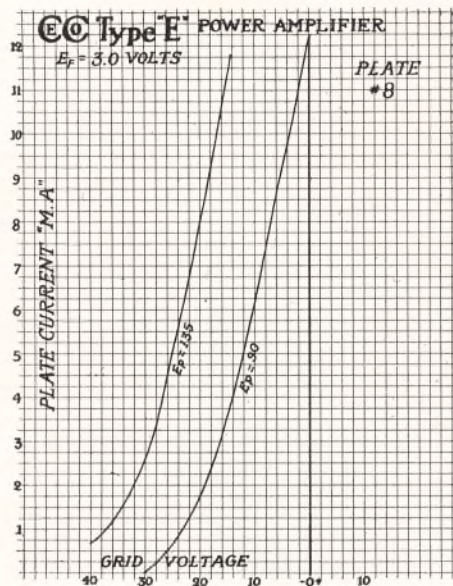
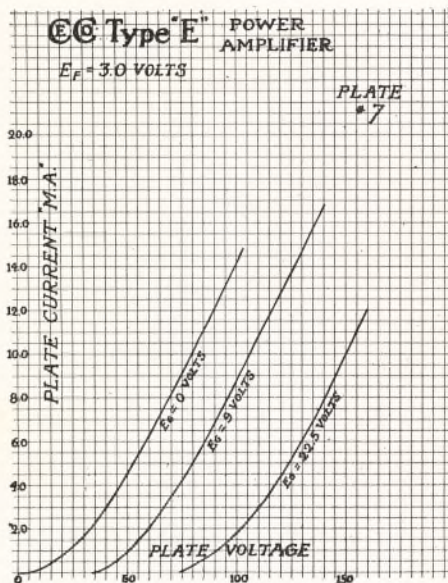
Plate 4 shows the change of plate current, plate impedance, and mutual conductance with plate voltage. Note also in this case that, without bias, little is to be gained above 60 volts B battery, while the B battery drain at 90 volts is double that at 60 volts.

Plate 5 shows the proper bias to be about 3 volts with 40 volts B, and 6 volts with 90 volts B. This allows a fairly large output for small loudspeakers, although CeCo type E is best for the last stage of audio.

Plate 6 shows the constancy of μ , with proper grid bias, and the impedance at 90 volts B, and 4.5 C to be low enough for the usual small loudspeakers.



Characteristics of CeCo Tubes



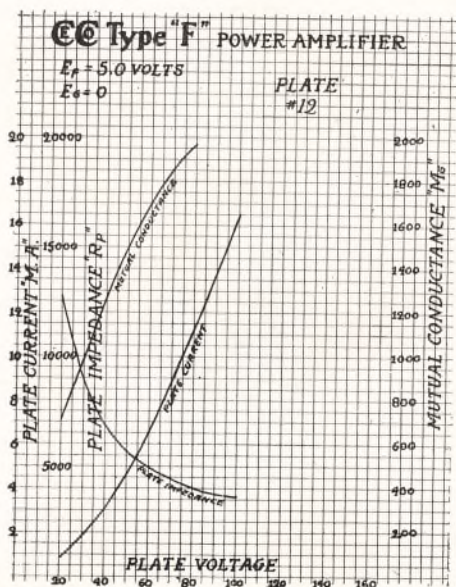
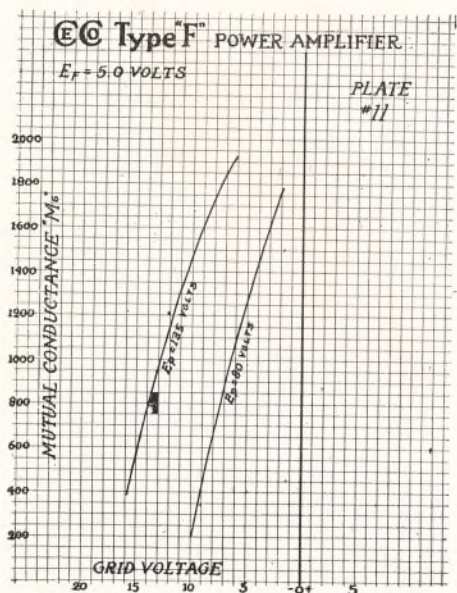
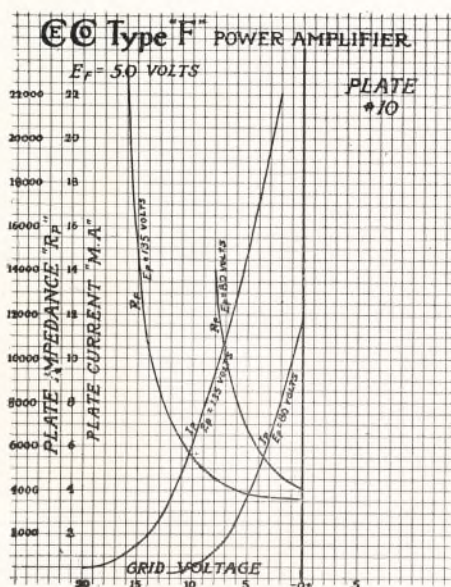
CeCo Type E

Plate 7 shows the plate currents to be expected at various B & C Voltages.

Plate 8 shows the large bias needed for this tube, and the consequent ability to handle high input voltages.

Plate 9 shows the high mutual conductance of this type, and the greatly lowered impedance, suiting it as an output tube to feed the latest type of low impedance speakers.

Characteristics of CeCo Tubes



CeCo Type F

Plate 10 shows the comparatively low plate current demanded at proper bias voltages by this "power" or output tube. Note also the very low impedance, eliminating to a great extent "flattening" or "breaking" of the low notes in audio amplification.

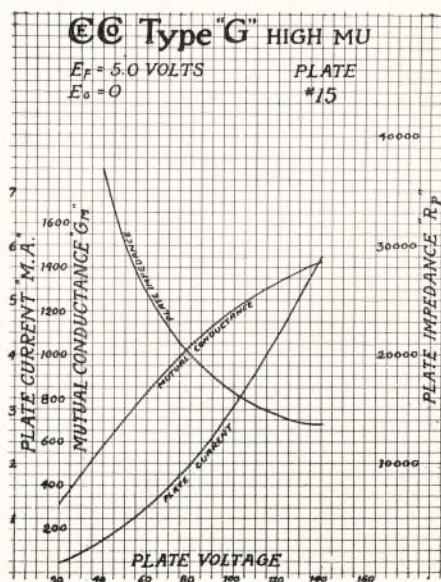
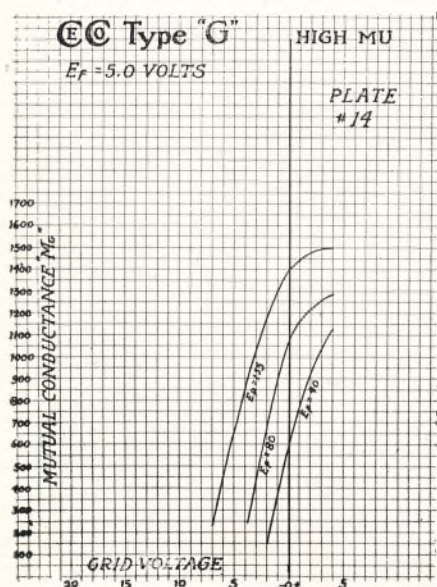
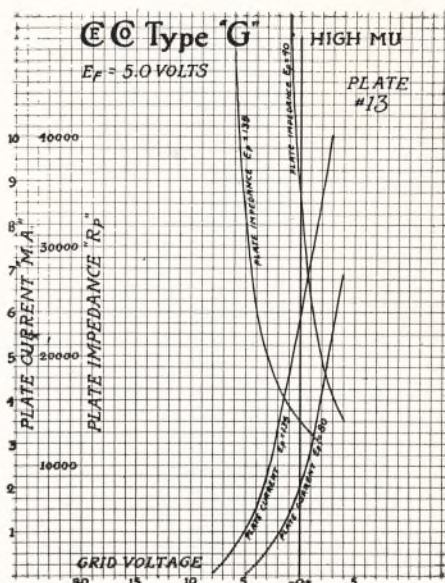
Plate 11 shows the extremely high mutual conductance of this tube. This and plate 10 show that, in connection with its μ of 8.0, it can be substituted for the A type in any stage of audio amplification. The owner of a set with the older type of low primary impedance transformers, can use it to advantage in *all* the audio stages, with great improvement in the quality of reception.

Plate 12 shows the effect of Plate voltage upon the other characteristics of this type.

This tube, unlike those using a filament of the oxid-coated type, can be used with plate voltages up to 200 without danger of impairing the vacuum. This ability to handle high voltages is due to the complete removal of occluded gases from the elements, during exhaustion.

Consequently the user of a CeCo type F need not fear that it will become gassy or give imperfect reproduction when loud signals are being received.

Characteristics of CeCo Tubes



CeCo Type G Mu 20

Plate 13 shows the impedance of this type to be much lower than other "high mu" tubes on the market, which makes a larger percentage of the mu available, when resistance coupling is employed. Note that by using 135 volts on the plate and the proper bias of about 4 volts, considerable power can be handled. This is of great importance in the latest impedance coupled amplifiers, where the usual "high mu" tube is overloaded in the second stage.

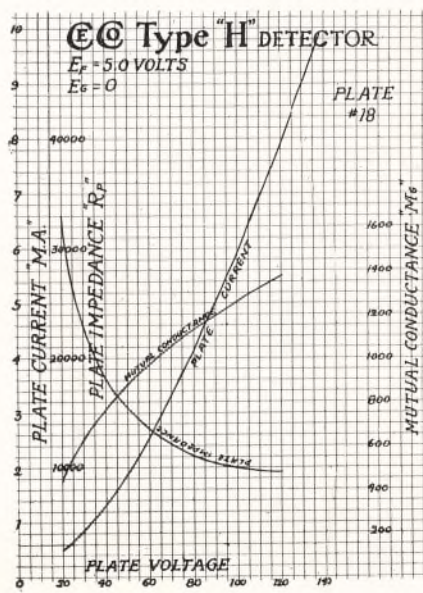
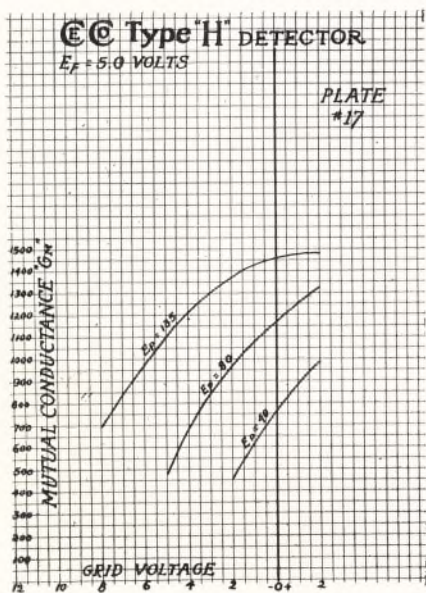
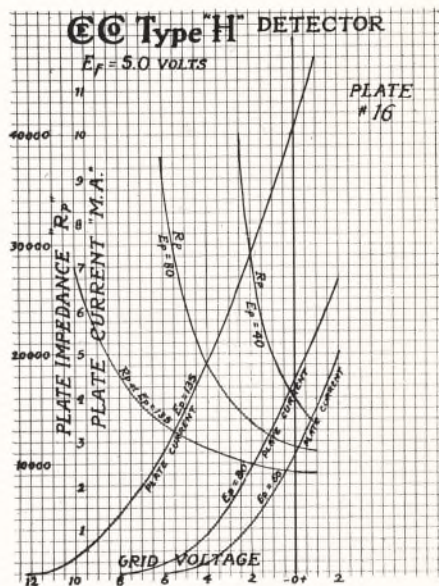
Plate 14 shows the high mutual conductance of this improved high mu type.

Plate 15 shows that for best results with resistance coupling, the B voltage should be kept as high as possible as with this system of amplification only a portion of it reaches the plate. With this CeCo voltage amplification tube, best results are usually had with coupling resistors of 50,000 to 75,000 ohms, unless the B battery exceeds 135 volts, when higher values can be used.

Mu 30

This company can also supply tubes of this character with a Mu of 30.

Characteristics of CeCo Tubes



CeCo Type H

Plate 16 shows the variation of plate current and impedance, with grid voltage, in the special CeCo Detector Tube. Note the curvature of the plate current-grid voltage curve, showing the great sensitivity of this tube when used as a detector without leak and condenser but with negative grid bias. This system of detection is of such excellent quality that it is found in the latest circuits, where the best reproduction and the sharpest tuning is needed. Its one drawback has been decreased sensitivity. The CeCo H type tube overcomes this, giving as great sensitivity with this method as with the more customary grid leak and condenser.

The great slope of these curves, however, also shows that improved sensitivity can be expected when the grid leak and condenser is employed, especially with about 80 volts on the plate.

The 135 volt curve shows the possibilities of this tube as an amplifier. At this voltage, with about 6 volts negative grid bias, amplification nearly double that of the A type may be obtained. This use of the tube is, however, usually confined to the stages preceding a power output tube such as type J71, which can handle the high voltages produced.

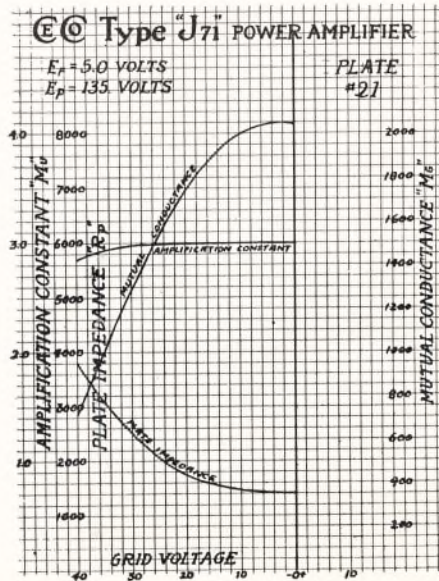
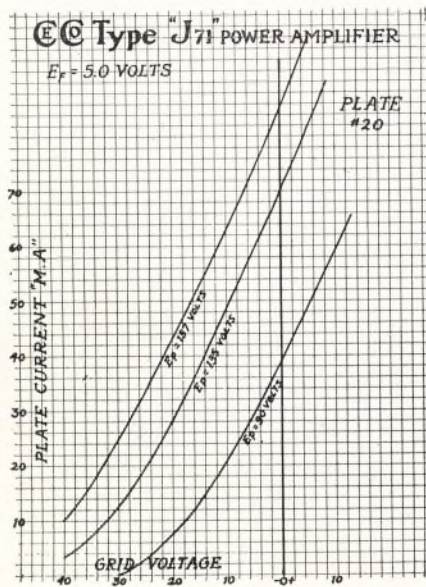
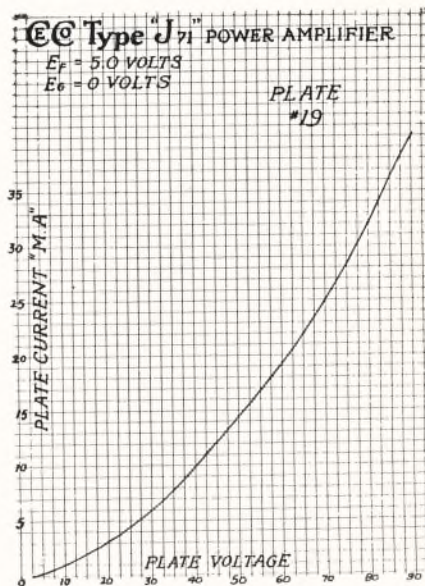
Finally, note the very low plate impedance at 80 volts, as compared with that of the usual detector tube, especially one of the gaseous type. This assures clear and distortionless reproduction with any modern amplifying system.

Plate 17 shows the exceptionally high mutual conductance of this type H, which with 80 volts on the plate is approximately 40% higher than the latest gaseous type detectors on the market, and manyfold times that of the usual alkali-metal detector. This makes for great volume, with less additional amplification needed.

Plate 18 shows especially the reduction in plate impedance to be gained by using 60 volts or more with this tube, with consequent lessened distortion.

The characteristic curves of this type cannot show the effect of the special internal construction, which prevents mechanical vibration of the elements—(microphonic noise) or the absolutely quiet background of reception assured by the perfect vacuum in conjunction with the above features. This tube is likewise non-critical in all its adjustments, as is shown by the even slope of the curves.

Characteristics of CeCo Tubes



CeCo Type J71

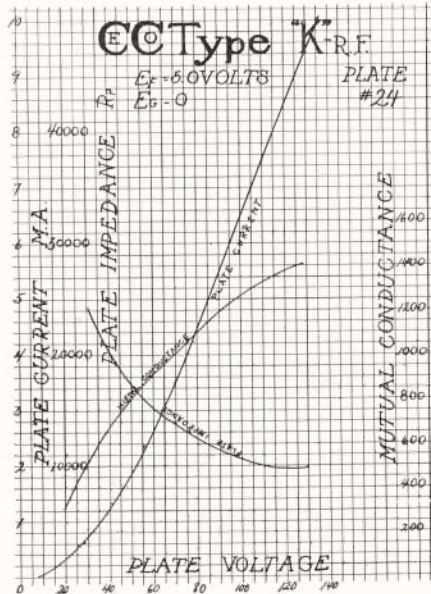
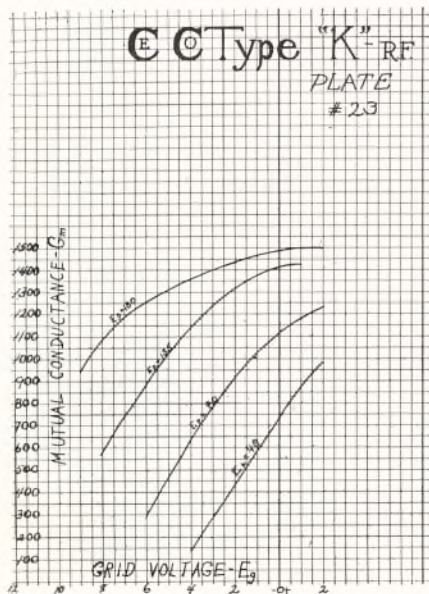
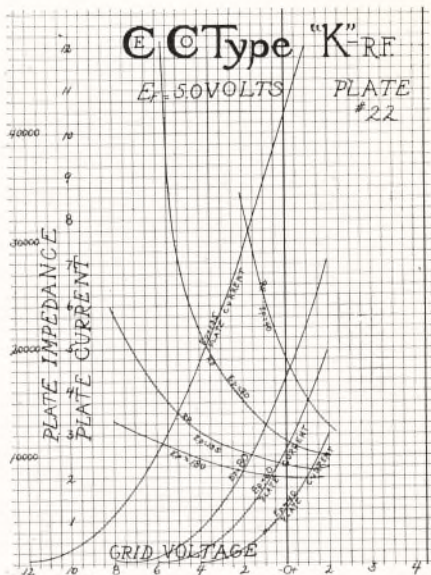
Plate 19 shows the heavy plate current necessarily drawn by this power amplifier. Proper provision for B supply, and either an output transformer or else a condenser-choke coil combination should be employed to keep this heavy D. C. current out of the loudspeaker windings.

Plate 20 shows the great voltage input which this tube can handle, even with 90 volts plate battery—about three times that possible with the CeCo F type. On the other hand, this tube is *only* superior to the F type when the grid is supplied with a high input voltage, either by using a modern type, high-ratio audio transformer, or else by using another extra stage of audio amplification preceding it.

Plate 21 shows the μ to be low, so that for circuits whose peak input voltages to the last stage do *not* exceed about 8 volts, the CeCo type F, with 135 volt battery, B will give louder response. The plate impedance is so very low that the modern low-impedance loud speaker will, when used with this J71 tube give volume reproduction of the lowest notes of the musical gamut.

The CeCo type J-71 tube is a special purpose tube not adapted for substitution in the ordinary set on the market today, without some rewiring. If an output transformer or choke coil is used, the primary D. C. resistance must be very low, as the I R drop with the heavy plate current of this tube is considerable. Sufficient bias must always be used, both to secure proper results and to avoid damage to the tube. Properly used in conjunction with a suitable speaker, this tube will reproduce both speech and music with volume and quality that leave nothing to be desired.

Characteristics of CeCo Tubes



CeCo Type "K"

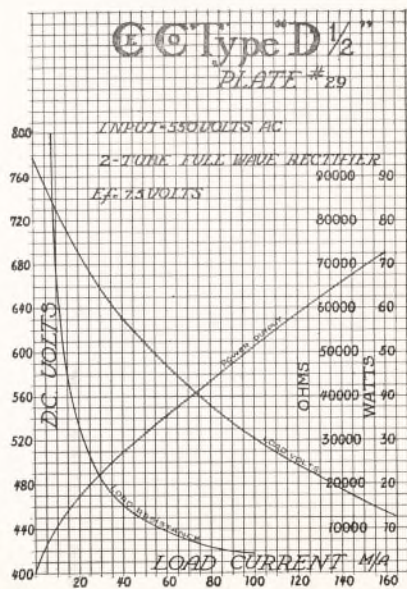
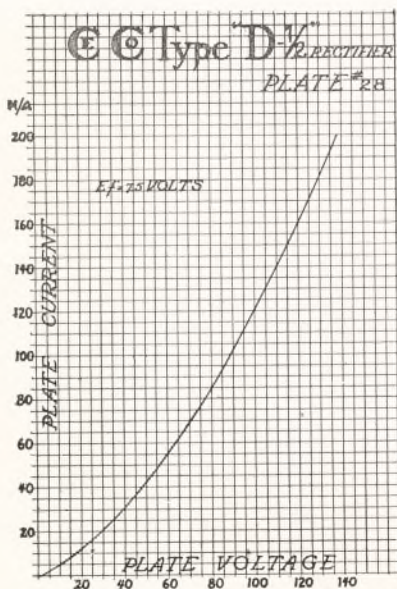
These Plates show the characteristics of this type of "CeCo" tube to be well adapted for Radio Frequency Amplification with the usual transformers employed today in T. R. F. sets.

Note that the factor μ_2/R_p in the case of this tube is about twice that of CeCo Type "A". This is the "figure of merit" of a Radio Frequency Amplifier tube.

The use of this tube is only contra-indicated when the set is not supplied with adequate provision for compensation of the secondary effects of feed-back through inter-electrode capacities.

A study of these Plates also shows the great possibilities of this tube as an Audio Frequency Amplifier, provided plate voltage from 120 to 200 are used, and the proper bias battery. This use of the tube is only indicated when interstage transformers have adequate primary impedance, i. e., when they are of modern construction.

Characteristics of CeCo Tubes

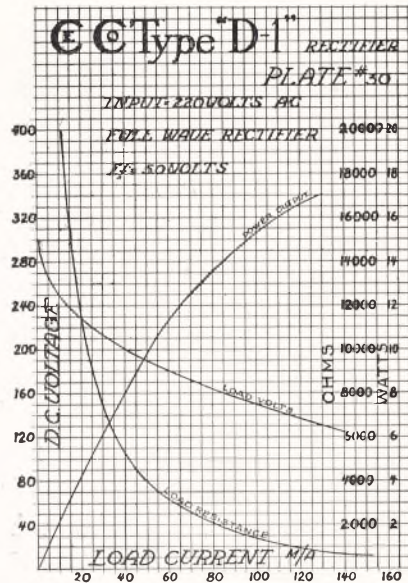


CeCo Type D $\frac{1}{2}$

Plate 28 shows the output of this heavy duty rectifier. To insure proper life not more than 65 M/A should be passed thru this rectifier and the filament voltage should be kept within 5% of the rated value when currents of over 50% of this figure are being handled. Output control by filament regulation is not advised.

Plate 29 shows the average results of a full wave rectifier using two of these tubes with 550 volts on the plate of each tube. Such an outfit is capable of supplying plate voltage to the largest power amplifier in ordinary use. This might be 2 "CeCo" type L-10 used in a push pull amplifier. Ample provision is thus made for voltage drop in output circuits.

Characteristics of CeCo Tubes



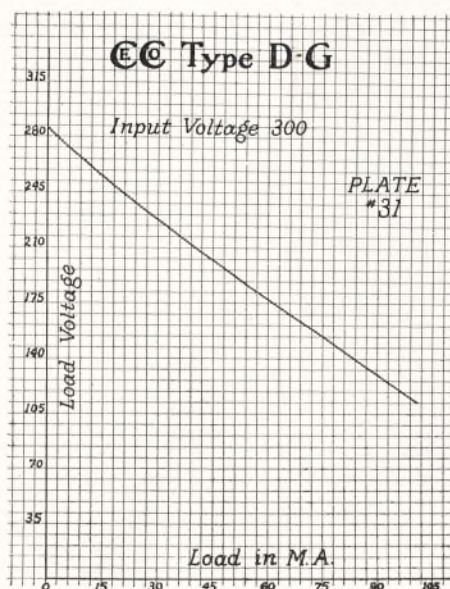
CeCo Type D-1

Plate 30 shows the performance of this tube in an average full wave rectifier. Such an outfit will supply sufficient plate voltage for most receivers on the market today, including the use of a "CeCo" J-71 output tube. For somewhat larger demands an input of 270 to 300 volts A C is permissible where the current does not exceed 50 M/A. This allows the maximum output of a CeCo J-71 to be obtained.

"CeCo" Type D $\frac{1}{2}$ is the ideal rectifier for use with the average receiver where the drain is less than 65 M/A, giving a good wave form for filter purposes, with minimum production of troublesome harmonics.

Voltages exceeding 300 R. M. S. are not to be used with this type. Use CeCo type D $\frac{1}{2}$ in case higher voltage is needed.

Characteristics of CeCo Tubes



CeCO Type DG

Gas Filled Rectifier

No Filament

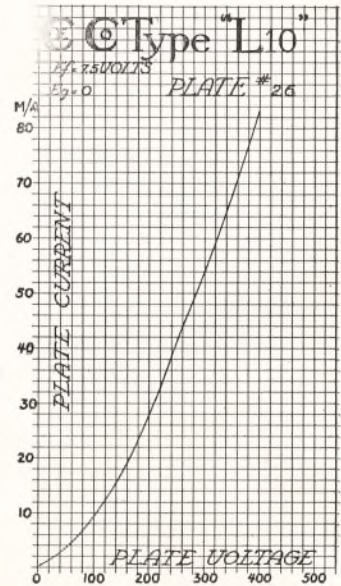
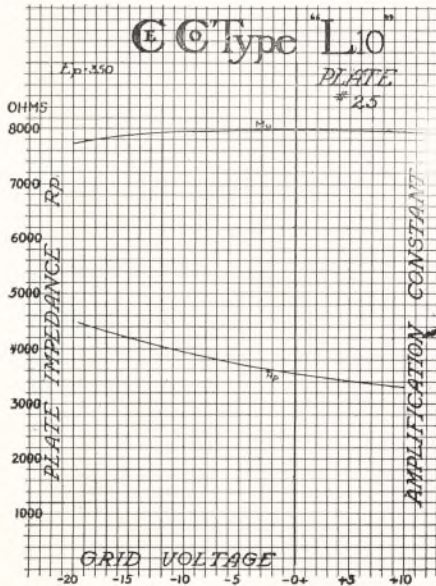
Plate No. 31 shows the voltage output of type DG plotted against current output.

This curve was taken with an average B Eliminator giving 300 volts per anode.

With B Eliminators having other characteristics, a different curve will be obtained.

The uniform slope of this curve shows the regular performance of the Type DG over a wide range of voltages.

Characteristics of CeCo Tubes



CeCo Type L-10

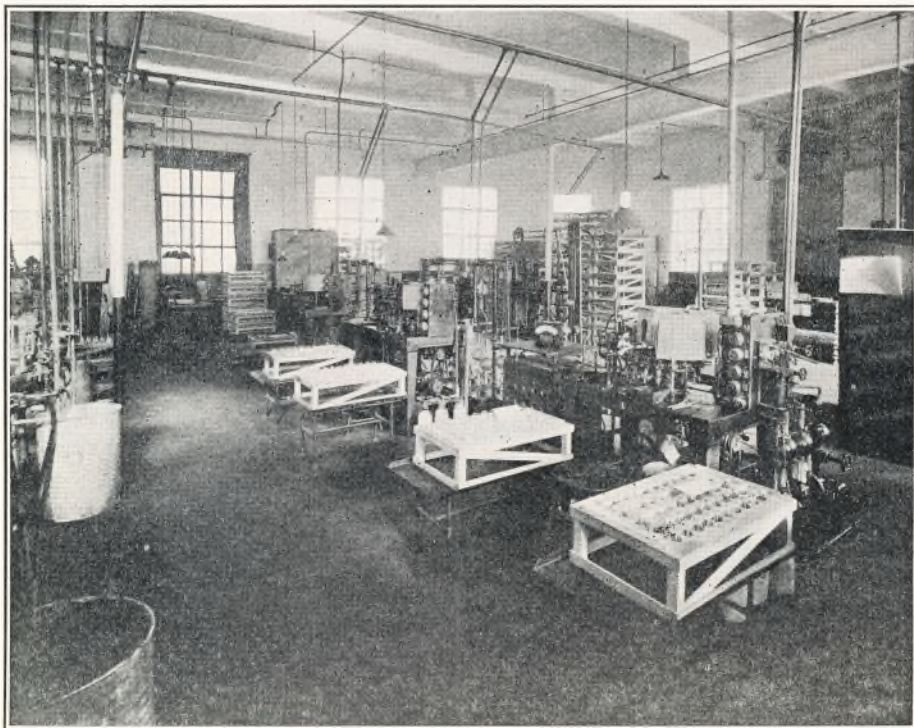
Plate 25 shows the high amplification and low impedance of this type, which secures great volume and excellent reproduction with a modern low-impedance speaker.

Plate 26 shows the heavy plate current of this tube, absolutely requiring some form of output circuit to keep the D. C. out of the speaker. A circuit which also isolates the speaker from the high voltage used with this tube is desirable.

"CeCo" type L-10 is a special purpose tube only for use in especially designed power amplifiers and is only recommended where voltages above 200 are available for the plate supply. Below this voltage, CeCo type J-71 is usually preferable.

Proper grid bias is, of course, absolutely demanded with this type tube.

View of Exhausting Dept.



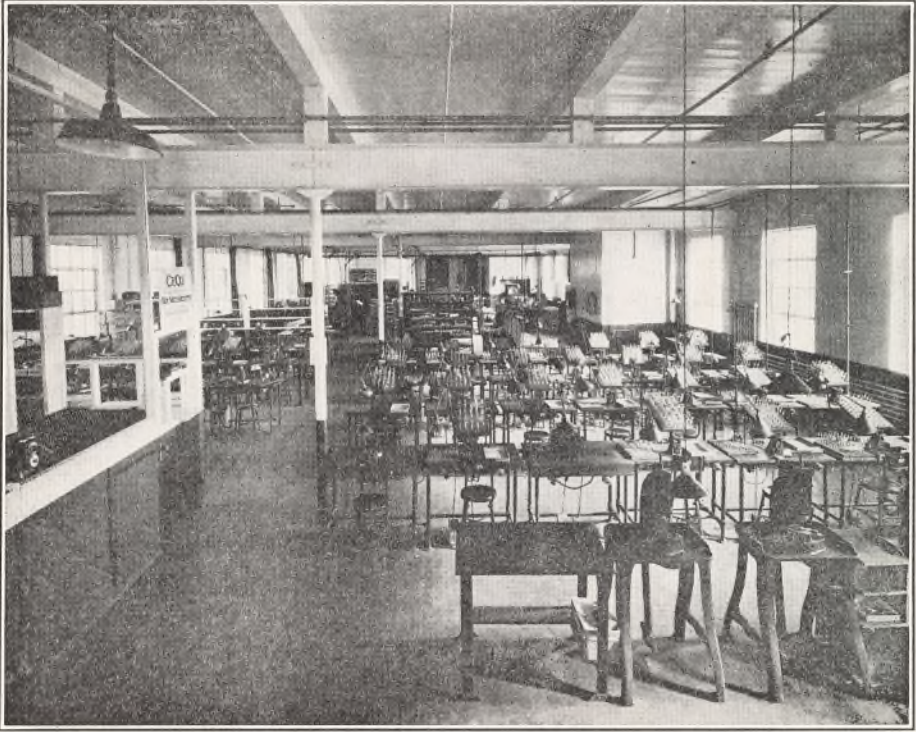
The earlier type of vacuum tubes were not very efficient. They had extremely short life and this was due to the lack of knowledge and proper equipment possessed by tube manufacturers at that time.

It must be realized that the vacuum tubes used in radio reception are an excellent example of the quantity production of what is really a scientific laboratory piece of apparatus. Keeping this in mind, manufacturers commenced experimenting on proper evacuation of radio tubes. Poor vacuum is one of the chief reasons for low life in tubes in the past.

The C. E. Manufacturing Company has developed a process of evacuation which is superior to that used by other tube manufacturers. One of the reasons for long life CeCo tubes.

A section of this Exhaust Department is shown in the above picture.

View of General Assembly Dept.



"CeCo" tubes are manufactured in Providence, Rhode Island and in a plant that is second to none in the United States. Its present production capacity is approximately 12,000 tubes per day. No expense is spared in the manufacture of "CeCo" tubes.

Special designed jigs and fixtures are used during the assembling of "CeCo" tubes which assure extremely uniform tubes.

A view of our General Assembling Department is shown.

Service

A large stock of all types is always carried on hand and all shipments are made the same day order is received. Shipments are always made via express unless otherwise specified.

Special Purpose Tubes

We are also prepared to make tubes in quantities for any purpose. Samples will be made up by the Engineering Department, if data or purpose for which tubes are desired, is furnished.

Care in Handling

A large number of broken filaments occur through careless handling of tubes. This is especially true of "B" (or 199 type); in addition, the efficiency of the tube is generally impaired by rough usage. We suggest that where an adapter is used with "B" type that tube be first inserted in adapter before placing in set socket. Our "C" type eliminates the separate adapter and is more economical and prevents breakage.

Rejuvenation

"CeCo" tubes can be rejuvenated by following instructions as outlined on instruction sheet packed with each tube.

Guarantee

We guarantee each and every CeCo tube to be electrically and mechanically perfect before leaving our factory. Therefore the only possible causes for a defective tube would be rough handling in transit.

Terms

All tubes are shipped F. O. B. Factory, strictly 30 days net with a liberal cash discount for 10 days payment, and our jobber's discounts are the same throughout the country.

Packing



Each "CeCo" tube is wrapped in cotton batting and around this is placed an instruction sheet; this is now encased in a corrugated protector and then inserted in an individual carton bearing the trademark name and type of tube.

All types "CeCo" tubes are packed 50 tubes to a case (standard packing) in an inner corrugated carton which is placed in a heavy outer corrugated case. Between the outer and inner container there is a protection of $2\frac{1}{2}$ inches of excelsior on all sides, including top and bottom.

Testing of tubes by jobbers:

Most jobbers test tubes before delivery to dealers. In the case of CeCo tubes this is not in our opinion necessary, but should such be the case we call attention to the fact that the proper potentials be applied. The meters on the testing apparatus should be checked periodically, as in our experience we have found defective instruments on some of the present tube testing apparatus. All CeCo tubes are very thoroughly tested at the plant and unless mishandled in transit should arrive in perfect condition.



A

EC

TUBE

For Every Radio Need

—AND—

Each Will Fulfil

Our Promise


To Make

A Good Receiver

Better



A More
Desirable
Line of Radio Tubes
is not
Marketed



No compromise is ever
countenanced in the
construction of



PRODUCTS

Quality First and Last

C.E. Mfg. Co., Inc.
702 Eddy St.
Providence R.I.